REMARKS

The present application includes claims 1-62. Claims 1-6 and 9-53 were rejected by the Examiner. Claims 7-8 were objected to by the Examiner. Claims 54-62 have been allowed by the Examiner. Claims 7 and 8 have been amended by this response.

Claims 7-8 were objected to as being dependent upon a rejected base claim, but would be allowable if rewritten as independent claims. By this Amendment, claims 7-8 have been rewritten in independent form. Therefore, the Applicant respectfully submits that claims 7-8 are allowable.

Claims 1-6 were rejected under 35 U.S.C. 102(e) as being anticipated by Gururaja '140 (U.S. Pat. No. 6,467,140).

Claims 1 and 9-15 were rejected under 35 U.S.C. 102(e) as being anticipated by Seyed-Bolorforosh et al. (U.S. Pat. No. 5,638,822).

Claims 1, 16-17, 43-44, and 51-53 were rejected under 35 U.S.C. 102(b) as being anticipated by Hossack (U.S. Pat. No. 5,957,851).

Claims 18-40 were rejected under 35 U.S.C. 103(a) as being unpatentable over Seyed-Bolorforosh, in view of Hossack.

Claims 41-50 were rejected under 35 U.S.C. 103(a) as being unpatentable over Gururaja '205 (U.S. Pat. No. 5,410,205), in view of Hossack.

The Applicant first turns to the Examiner's rejection of claims 1-6 over Gururaja '140. Gururaja '140 relates to a method for making piezoelectric transducers. Gururaja '140 focuses on reducing the electrical impedance of the transducer elements to match the equipment the transducer elements are connected to while also optimizing the acoustic impedance match of the transducer elements to the human body (col. 3, lines 61-63). Gururaja '140 uses an electrode **240**, wafer **235**, and electrode **242** to form a combination **250** (col. 7, lines 6-7). Multiple combinations **250**, separated by a layer of passive polymer **238**, are used to form a single composite transducer element **230** (col. 6, lines 51-67, col. 7, lines 1-11). The purpose of the multiple combinations **250** in forming a single composite transducer element **230** is to increase the overall capacitance of the transducer element (col. 7, lines 6-25). The increased capacitance reduces the corresponding electrical impedance (col. 4, lines 9-13). In addition, the separation of multiple combinations **250** by passive polymer layers **238** results in a composite structure with low acoustic impedance (col. 4, lines 18-22). Gururaja '140 does not address the processing of the transmitted pulses or the received signals beyond indicating that the transducer would be used as part of a larger system (col. 5, lines 28-57). However, Gururaja '140 does show only a single transmitter **107** and a single set of receiving circuitry (preamplifier **109**, beam former **106**, signal processor **105**) for the transducer **101** (col. 5, lines 28-57).

The present application relates to a transducer element comprising a first active transducer layer and a second active transducer layer. The first active transducer layer is connected to a first receiver and a first transmitter. The second active transducer layer is connected to a second receiver and a second transmitter. The second active transducer layer is laminated to the first active transducer layer to form the transducer element.

Gururaja '140 does not teach laminating two active transducer layers together, as recited in independent claim 1 of the claimed invention. Rather, Gururaja '140 focuses on using multiple combinations to form a single active transducer element. Gururaja '140 uses only a single transmitter and a single receiver, whereas the claimed invention uses a separate transmitter and receiver for each active transducer layer, as recited in independent claim 1. Further, since Gururaja '140 uses only a single active transducer layer, Gururaja '140 does not teach laminating two active transducer layers together.

Additionally, Gururaja '140 does not teach passive circuitry for processing a first pulse and a second pulse, as recited in dependent claims 2-5. Again, Gururaja '140 uses only a single active transducer layer.

Therefore, Gururaja '140 does not teach the limitations of independent claim 1 of the present application. Accordingly, Gururaja '140 also does not teach the limitations of dependent claims 2-6. Thus, the Applicant respectfully submits that independent claim 1, and its dependent claims, are patentable over the prior art.

The Applicant next turns to the Examiner's rejection of claims 1 and 9-15 over Seyed-Bolorforosh. Seyed-Bolorforosh relates to an ultrasonic probe or transducer with a plurality of piezoelectric layers stacked in such a way that the oscillation resonance frequency may be changed (col. 3, line 6, col. 4, lines 64-67). Seyed-Bolorforosh focuses on a single transducer element composed of a plurality of piezoelectric layers (col. 2, lines 57-66, col. 9, lines 45-47). Seyed-Bolorforosh uses switching circuitry to selectively enable piezoelectric layers of the transducer (col. 10, lines 26-29). The switching circuitry permits the piezoelectric element to

transmit or receive acoustic waves at different frequencies (col. 10, lines 30-33). The switching circuitry does not switch the transducer from a transmit mode to a receive mode. Although each piezoelectric layer can be independently turned on and off (col. 10, lines 11-13), only a single signal generator **70** is connected to the piezoelectric element (col. 10, lines 18-20). Thus, Seyed-Bolorforosh teaches only a single active transducer layer with a single transmitter and a single receiver.

The present application relates to a transducer element comprising a first active transducer layer and a second active transducer layer. The first active transducer layer is connected to a first receiver and a first transmitter. The second active transducer layer is connected to a second receiver and a second transmitter. The second active transducer layer is laminated to the first active transducer layer to form the transducer element.

Seyed-Bolorforosh does not teach laminating two active transducer layers together, as recited in independent claim 1 of the claimed invention. Seyed-Bolorforosh instead uses multiple piezoelectric layers to form a single active transducer layer. Seyed-Bolorforosh also does not teach a first active transducer layer connected to a first receiver and a first transmitter and a second active transducer layer connected to a second receiver and a second transmitter. This limitation is recited in independent claim 1.

In addition, Seyed-Bolorforosh does not teach the limitations of dependent claims 9-15. For example, Seyed-Bolorforosh does not teach a switch for switching the transducer element from a transmit mode to a receive mode, as recited in dependent claim 9 of the claimed invention. Seyed-Bolorforosh instead uses switching circuitry to alter the frequency at which the transducer element can transmit or receive acoustic waves.

Therefore, Seyed-Bolorforosh does not teach the limitations of independent claim 1 of the present application. Accordingly, Seyed-Bolorforosh also does not teach the limitations of dependent claims 9-15. Thus, the Applicant respectfully submits that independent claim 1, and its dependent claims, are patentable over the prior art.

The Applicant next turns to the Examiner's rejection of claims 1, 16-17, 43-44, and 51-53 over Hossack. Hossack relates to an extended bandwidth ultrasonic transducer. Hossack uses a transducer element **50** formed by multiple layers of transducer material (col. 5, lines 66-67). Two transducer layers are disposed together, or there may be intermediate layers of piezoelectric or non-piezoelectric layers between them (col. 6, lines 1-6). The second transducer layer is connected to a single transceiver (col. 6, lines 58-62). The first transducer layer is coupled to the same transceiver through a diode (col. 6, lines 62-64). The diode allows the first transducer layer to be excited in the transmit mode of the transducer element (col. 7, lines 16-24). However, in reception mode, the diode isolates the first layer from the transceiver (col. 7, lines 29-37). Hossack describes many alternative ways of isolating one or multiple layers of a multi-layer transducer from the transceiver during reception in **FIGS. 10-15** (col. 8, lines 1-4, col. 9, lines 4-13). In addition, Hossack uses switching circuitry to switch between receiving on multiple transducer layers or only on a single transducer layer, depending on the type of signal of interest (col. 9, lines 14-31).

The present application relates to a transducer element comprising a first active transducer layer and a second active transducer layer. The first active transducer layer is connected to a first receiver and a first transmitter. The second active transducer layer is

connected to a second receiver and a second transmitter. The second active transducer layer is laminated to the first active transducer layer to form the transducer element.

Hossack does not teach connecting a first active transducer layer to a first receiver and a first transmitter and connecting a second active transducer layer to a second receiver and a second transmitter. This limitation is recited in independent claims 1,16-17, and 51 of the claimed invention. Hossack instead uses a single transceiver that is connected to all active transducer layers. In addition, Hossack does not teach passive circuitry wherein a first pulse produced by the first transmitter and a second pulse produced by the second transmitter are processed by the passive circuitry prior to being combined into a single ultrasound pulse. This limitation is recited in independent claim 16. Hossack also does not teach first and second receivers that each comprise an electrical filtering device to optimize a combined received electrical pulse prior to image coding. This limitation is recited in independent claim 17.

Further, Hossack does not teach a transducer element having a first active transducer layer connected to a first transmitter and a second active transducer laminated to the first active transducer layer and connected to a second transmitter, as recited in independent claim 43. Hossack also does not teach a transducer element comprising a first active transducer layer connected to a first receiver and a second active transducer layer connected to a second receiver, as recited in independent claim 44. Hossack instead uses a single transceiver that is connected to all active transducer layers.

Therefore, Hossack does not teach the limitations of independent claims 1, 16-17, 43-44, and 51 of the present application. Accordingly, Hossack also does not teach the limitations of

dependent claims 52-53. Thus, the Applicant respectfully submits that the independent claims 1, 16-17, 43-44, and 51-53, and their dependent claims, are patentable over the prior art.

The Applicant next turns to the Examiner's rejection of claims 18-40 over Seyed-Bolorforosh, in view of Hossack. As discussed above, Seyed-Bolorforosh focuses on a single transducer element composed of a plurality of piezoelectric layers. Seyed-Bolorforosh uses switching circuitry to selectively enable piezoelectric layers of the transducer, permitting transmission or reception of acoustic waves at different frequencies.

As discussed above, Hossack uses a transducer element formed by multiple layers of transducer material. Only a single transceiver is used for all of the transducer layers in the transducer element.

Also, as discussed above, the present application uses a first receiver connected to a first active transducer layer and a second receiver connected to a second active transducer layer.

Neither Seyed-Bolorforosh nor Hossack, alone or in combination, teach or suggest the limitations of the claimed invention. Seyed-Bolorforosh does not teach or suggest using first and second receivers for first and second active transducer layers, as recited in independent claim 18. Rather, Seyed-Bolorforosh uses a single active transducer layer with switching circuitry to select the reception frequency of that layer. Hossack does not teach or suggest using a separate receiver for each active transducer layer, as recited in independent claim 18. Rather, Hossack uses a single transceiver potentially connected to one or more active transducer layers.

Additionally, there is no suggestion in the art to combine Seyed-Bolorforosh with Hossack. Even assuming for the sake of argument that Seyed-Bolorforosh may be combined

with Hossack, the combination still does not teach or suggest the limitations of the claimed invention. For example, Seyed-Bolorforosh and Hossack do not teach or suggest using a separate receiver for each active transducer layer, as recited in independent claim 18. Thus, neither Seyed-Bolorforosh nor Hossack, alone or in combination, teaches or suggests the limitations of the claimed invention. The Applicant respectfully submits that independent claim 18 and its dependent claims are patentable over the prior art.

The Applicant next turns to the Examiner's rejection of claims 41-50 over Gururaja '205, in view of Hossack. Gururaja '250 relates to an ultrasonic transducer having two or more frequencies. Gururaja '250 focuses on using multiple piezoelectric layers in a transducer to transmit and receive ultrasonic energy at more than one frequency (col. 2, lines 6-15). The frequency of the transducer is changed by independently changing the polarization of each piezoelectric layer (col. 2, lines 15-19, 35-46). The resonance frequency of the transducer can be changed between transmission and reception by changing the polarization of the piezoelectric layers (col. 5, lines 34-42). Gururaja '250 uses an array of the above described transducer elements that are physically separated so they can be individually energized (col. 3, lines 5-17).

As discussed above, Hossack uses a transducer element formed by multiple layers of transducer material. Only a single transmitter and a single receiver are used for all of the transducer layers in the transducer element.

Also, as discussed above, the present application uses first and second transmitters and receivers connected to first and second individual active transducer layers, respectively.

Neither Gururaja '205 nor Hossack, alone or in combination, teach or suggest the limitations of the claimed invention. Gururaja '205 does not teach or suggest arranging an array of active transducer layers to obtain frequency variable apodization across the array during transmission, as recited in independent claim 41. Rather, no apodization is discussed in Gururaja '205. Further, Gururaja '205 does not teach or suggest using a separate transmitter for each active transducer layer, as recited in independent claim 43. Additionally, Gururaja '205 does not teach or suggest using a separate receiver for each active transducer layer, as recited in independent claim 44. Rather, Gururaja '205 uses a single active transducer layer composed of multiple piezoelectric layers that can be reconfigured to transmit and receive at different frequencies by altering the polarization of each piezoelectric layer.

Hossack does not teach or suggest arranging an array of active transducer layers to obtain frequency variable apodization across the array during transmission, as recited in independent claim 41. Rather, no apodization is discussed in Hossack. Further, Hossack does not teach or suggest using a separate transmitter for each active transducer layer, as recited in independent claim 43. Additionally, Hossack does not teach or suggest using a separate receiver for each active transducer layer, as recited in independent claim 44. Rather, Hossack uses a single transmitter and a single receiver potentially connected to one or more active transducer layers.

Additionally, there is no suggestion in the art to combine Gururaja '205 with Hossack. Even assuming for the sake of argument that Gururaja '205 may be combined with Hossack, the combination still does not teach or suggest the limitations of the claimed invention. For example, Gururaja '205 and Hossack do not teach or suggest arranging an array of active transducer layers to obtain frequency variable apodization across the array during transmission,

as recited in independent claim 41. Further, Gururaja '205 and Hossack do not teach or suggest using a separate transmitter for each active transducer layer, as recited in independent claim 43. Additionally, Gururaja '205 and Hossack do not teach or suggest using a separate receiver for each active transducer layer, as recited in independent claim 44.

Thus, neither Gururaja '205 nor Hossack, alone or in combination, teaches or suggests the limitations of the claimed invention. The Applicant respectfully submits that independent claims 41, 43-44, and their dependent claims are patentable over the prior art.

Hanafy and Chen were also cited as prior art of record. However, Hanafy does not teach or suggest a first transmitter and a first receiver connected to a first active transducer layer and a second transmitter and a second receiver connected to a second active transducer layer. Chen also does not teach or suggest first and second transmitters and receivers connected to first and second active transducer layers, respectively. Therefore, the Applicants submit that the claims of the present application are allowable.

CONCLUSION

The Applicant submits that the present application is in condition for allowance. If the Examiner has any questions or the Applicant can be of any assistance, the Examiner is invited and encouraged to contact the Applicant at the number below.

The Commissioner is authorized to charge any necessary fees or credit any overpayment to the Deposit Account of GTC, Account No. 070845.

Respectfully submitted,

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Christopher N. George
Reg. No. 51,728

McAndrews, Held & Malloy, Ltd.
500 W. Madison Street
34th Floor
Chicago, Il 60661
Phone (312) 775-8000
Fax (312) 775-8100